Biological Assessment Report

Sni-A-Bar Creek
Jackson County, Missouri

Fall 2015 – Spring 2016

Prepared for:
Missouri Department of Natural Resources
Division of Environmental Quality
Water Protection Program
Water Pollution Control Branch

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1.0 Introduction

At the request of the Missouri Department of Natural Resources (**MoDNR**) Water Protection Program (**WPP**), the Environmental Services Program (**ESP**) Water Quality Monitoring Section (**WQMS**) conducted a macroinvertebrate biological assessment and habitat study of Sni-A-Bar Creek (water body identification number 0399), during the fall of 2015 and spring of 2016. WQMS staff collected macroinvertebrate and water quality samples from four Sni-A-Bar Creek stations in Jackson County, Missouri, in September 2015 and March 2016. Habitat assessments were conducted in September 2015.

Sni-A-Bar Creek is classified as a class P stream in the Missouri Water Quality Standards (**WQS**, MoDNR 2014) with the following designated uses: irrigation; livestock and wildlife watering; protection of warm water aquatic life and human health-fish consumption; category B whole body contact recreation; and secondary contact recreation. A class P stream is defined as a stream that maintains permanent flow even in drought periods. Category B whole body contact applies to waters that are not designated for public swimming areas and public recreational uses. Sni-A-Bar Creek is listed on the MoDNR 303(d) List of Impaired Waters for low dissolved oxygen levels from an unknown source.

2.0 Study Area

Sni-A-Bar Creek is a tributary of the Missouri River and originates in eastern Jackson County. Sni-A-Bar Creek is located within the Central Plains/Blackwater/Lamine Ecological Drainage Unit (**EDU**) (Figure 1). An EDU is a region in which biological communities and habitat conditions can be expected to be similar.

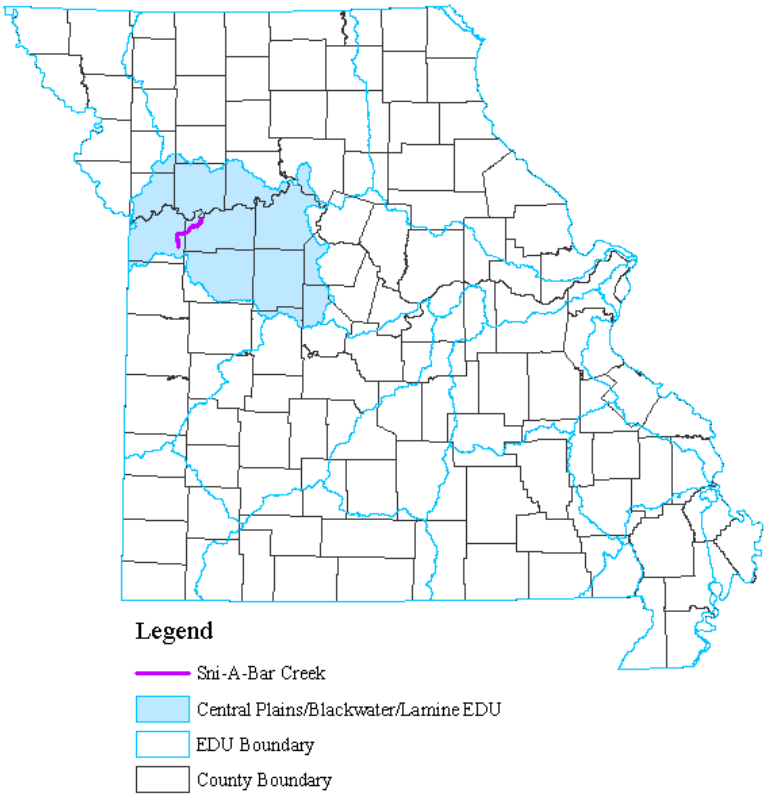

Figure 1. Location of Sni-A-Bar Creek within the
Central Plains/Blackwater/Lamine EDU

Stations for this study bracketed the Blue Springs Waste Water Treatment Facility (**WWTF**) (Permit #MO-0028886); one station was located upstream of the discharge point and three stations were located downstream of the discharge point. Station locations and descriptions are listed below and shown in Figure 2.

Sampling Locations

Sni-A-Bar Creek Station 1 (SE1/4, SE1/4, S. 20, T. 49 N., R. 29 W.) is located upstream of the Highway H bridge. Universal Transverse Mercator (**UTM**) coordinates collected at the downstream boundary of the sample reach are UTMN 4321724, UTME 402218.

Sni-A-Bar Creek Station 2 (NE1/4, SW1/4, S. 19, T. 49 N., R. 29 W.) is located south of Old Pink Hill Road. UTM coordinates collected at the downstream terminus of the sample reach are UTMN 4321849, UTME 399989.

Sni-A-Bar Creek Station 3 (NW1/4, NE1/4, S.25, T. 42 N., R. 30 W.) is located downstream of the bridge at Howell Road. UTM coordinates of the upstream terminus are UTMN 4321018, UTME 398368.

Sni-A-Bar Creek Station 4 (NE1/4, SW1/4, S.25, T. 49 N., R. 30 W.) is located approximately 0.85 miles upstream of the Blue Springs WWTF outfall. The UTM coordinates of the upstream terminus are UTMN 4320227, UTME 397630.

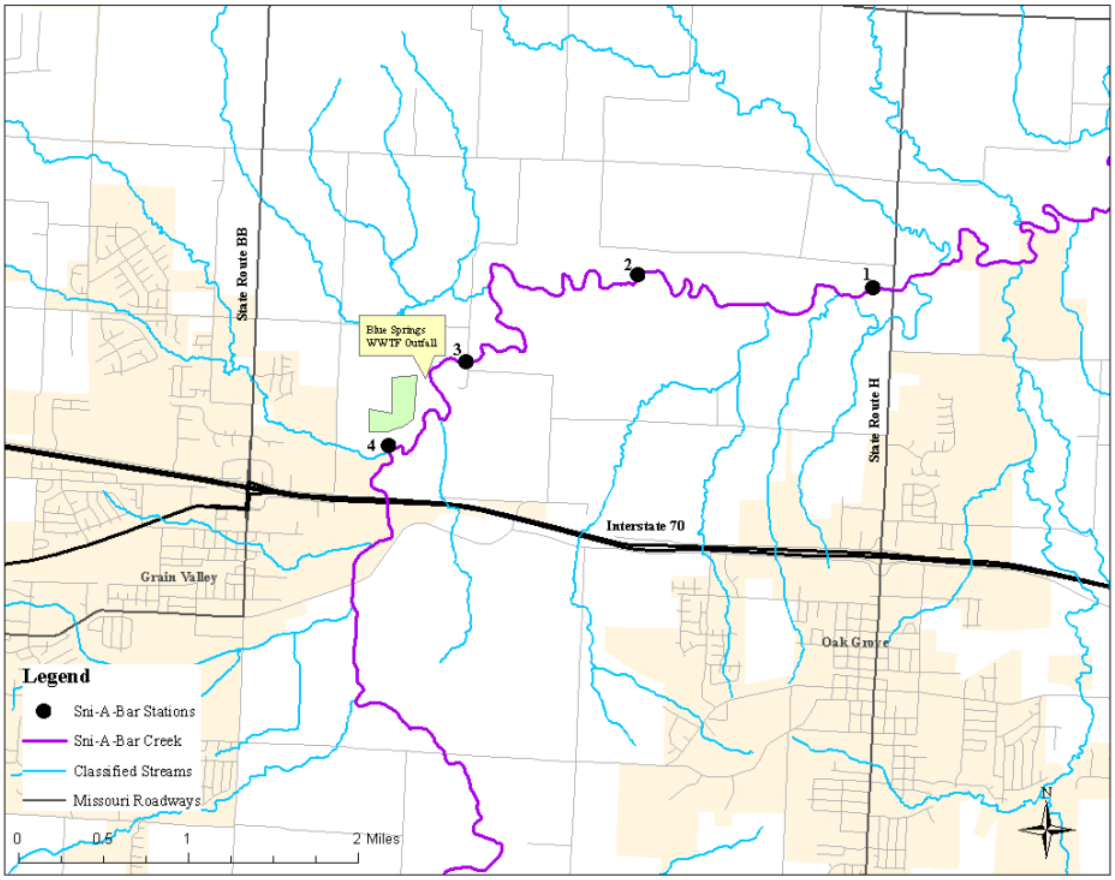

Figure 2. Sni-A-Bar Sampling Locations

3.0 Objectives

The primary objective of this study was to determine if Sni-A-Bar Creek supports its beneficial use designation of supporting aquatic life based on biological criteria calculated from reference stream macroinvertebrate data in the Central Plains/Blackwater/Lamine EDU. The macroinvertebrate community and instream habitat were compared longitudinally among four Sni-A-Bar Creek stations and compared with biological criteria reference (**BIOREF**) stream data from the Central Plains/Blackwater/Lamine EDU. Water quality and nutrient parameters were compared longitudinally among the Sni-A-Bar Creek study sites and also compared with Missouri's WQS (MoDNR 2014).

3.1 Null Hypotheses

1) Land cover characteristics in the Sni-A-Bar Creek watershed will be similar to land cover characteristics of the Central Plains/Blackwater/Lamine EDU.

2) Stream habitat assessment scores of Sni-A-Bar Creek will be similar to those of East Fork Crooked River, a BIOREF stream in the Central Plains/Blackwater/Lamine EDU.

3) The macroinvertebrate community in Sni-A-Bar Creek will be similar among longitudinally separate reaches of Sni-A-Bar Creek.

4) The macroinvertebrate community in Sni-A-Bar Creek will be similar to the macroinvertebrate community of BIOREF streams in the Central Plains/Blackwater/Lamine EDU.

5) Physicochemical water quality of Sni-A-Bar Creek will meet Missouri WQS (MoDNR 2014).

4.0 Methods

Macroinvertebrate sampling was conducted during fall 2015 and spring 2016 by the WQMS Aquatic Bioassessment Unit. Fall sampling was conducted on September 16-17, 2015, and consisted of macroinvertebrate sampling, stream habitat assessments, and water quality sampling at four stations on Sni-A-Bar Creek. During the spring, sampling was conducted on March 22, 2016, and consisted of macroinvertebrate sampling and water quality sampling at the same study stations. Sampling was conducted by Brandy Bergthold, Dave Michaelson, Carl Wakefield, and Brian Nodine. Methods for stream habitat assessments, biological assessments, and physicochemical water quality collection are included in this section.

4.1 Land Use Description

Table 2 compares the land cover percentages from the Central Plains/Blackwater/Lamine EDU and the 12-digit Hydrologic Unit Code (**HUC**) containing the study stations. Percent land use data were derived from Thematic Mapper satellite images from 2000-2004 and interpreted by the Missouri Resource Assessment Partnership (Sowa et al. 2004). Figure 3 depicts the land use characteristics of the 12-digit HUC containing the Sni-A-Bar Creek sampling reach.

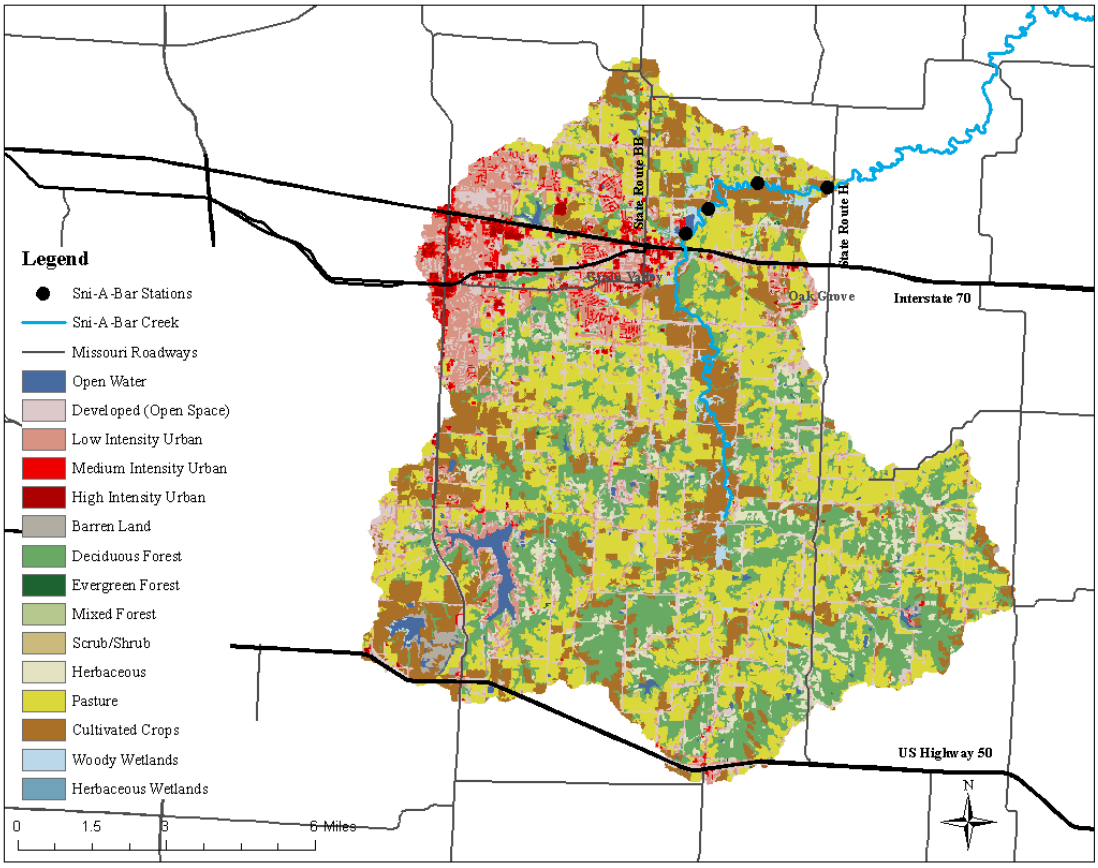

Figure 3. Land uses within the 12 digit HUC of Sni-A-Bar Creek

4.2 Stream Habitat Assessment Project Procedure

Standardized assessment procedures were followed as described for glide/pool prevalent streams in the Stream Habitat Assessment Project Procedure (**SHAPP**, MoDNR 2016i). According to the SHAPP, an aquatic community is influenced by the quality of the stream habitat. Stream habitat quality is scored for each station and the scores are compared with a control stream (BIOREF reach) SHAPP score. If the SHAPP score at a study station is ≥75% of the SHAPP control score, the stream habitat at the study station is considered to be comparable to the control stream. East Fork Crooked River, located northeast of Richmond in Ray County, Missouri, is a BIOREF stream that was chosen as the SHAPP control. The habitat assessment of East Fork Crooked River was conducted on September 17, 2015. SHAPP scores were calculated for the Sni-A-Bar Creek stations, compared to East Fork Crooked River, and examined for irregular results.

4.3 Bioassessment

4.3.1 Macroinvertebrate Sampling and Analyses

Macroinvertebrate sampling was conducted according to the Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (**SMSBPP**, MoDNR 2012). Sni-A-Bar Creek is considered a glide/pool dominated system. The three standard

habitats sampled at all locations were non-flowing water over depositional substrate, large woody debris substrate, and submerged rootmat. Macroinvertebrate samples were subsampled in the laboratory and identified to specific taxonomic levels (MoNDR 2016j) in order to develop biological metric values (MoDNR 2012).

Sni-A-Bar Creek macroinvertebrate data were evaluated relative to BIOREF streams in the Central Plains/Blackwater/Lamine EDU. Biological criteria are calculated separately for the fall (mid-September through mid-October) and spring (mid-March through mid-April) index periods. The SMSBPP provides details on the calculation of metrics and scoring of the multi-metric Macroinvertebrate Stream Condition Index (**MSCI**). The four components of the MSCI are Taxa Richness (**TR**); Ephemeroptera, Plecoptera, and Trichoptera Taxa (**EPTT**); Biotic Index (**BI**); and the Shannon Diversity Index (**SDI**). An MSCI score of 16-20 is considered fully supporting, 10-14 partially supporting, and 4-8 non-supporting of the protection of warm water aquatic life beneficial use designation as listed in the Missouri WQS (MoDNR 2014).

4.3.2 Physicochemical Water Sampling and Analyses

Physicochemical water samples were handled according to the appropriate MoDNR ESP Standard Operating Procedure (**SOP**) or Project Procedure (**PP**). Results for physicochemical water parameters were examined by season and station by field measurements or grab samples collected in accordance with the SOP MDNR-ESP-001, *Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations* (MoDNR 2016h). All samples were kept on ice during transport to ESP.

Water quality parameters were measured *in-situ* or collected and returned for analyses at the ESP laboratory in Jefferson City. Turbidity (**NTU**, MoDNR 2016a) was measured in the ESP, WQMS biology laboratory. Discharge (cubic feet per second-cfs, MoDNR 2015), dissolved oxygen (mg/L, MoDNR 2016b), specific conductance (µS/cm, MoDNR 2016c), pH (MoDNR 2016d), and temperature (°C, MoDNR 2016e), were measured in the field. The ESP Chemical Analysis Section (**CAS**) conducted analyses for the following: calcium, magnesium, hardness as $CaCO_3$, sulfate, ammonia-nitrogen, nitrate+nitrite-nitrogen, total nitrogen, total phosphorus, chloride, and total suspended solids/non-filterable reside (all parameters reported in mg/L).

Physicochemical water parameters were compared among stations as well as with Missouri's WQS (MoDNR 2014). Interpretation of acceptable limits in the WQS may be dependent on a stream's classification and beneficial uses as designated in the WQS (MoDNR 2014).

4.3.3 Discharge

Stream discharge was measured using a SonTek/YSI FlowTracker Handheld Acoustic Doppler Velocimeter at all stations during both sampling seasons in accordance with the SOP MDNR-ESP-113, *Flow Measurements in Open Channels* (MoDNR 2015).

4.4 Quality Assurance/Quality Control (QA/QC)

4.4.1 Field Meters

All field meters used to collect water quality parameters were maintained in accordance with *Quality Control Procedures for Checking Water Quality Field Instruments* (MoDNR 2016f).

4.4.2 Biological Samples

Steps to assure accuracy of organism removal from sample debris were performed consistent with those methods found in the SMSBPP document (MoDNR 2012).

4.4.3 Biological Data Entry

All macroinvertebrate data were entered into the WQMS macroinvertebrate database consistent with *Quality Control Procedures for Data Processing* (MoDNR 2016g).

4.4.4 Duplicate Sample Collection

Duplicate samples are obtained from the same location at essentially the same time as the true sample following the same procedures in accordance with *Quality Assurance/Quality Control for Environmental Data* Collection (MoDNR 2013). The true samples and the duplicate samples are analyzed for the same set of parameters. A duplicate is used to assess the precision associated with sampling methodology, sample heterogeneity, and analytical procedures (MoDNR 2013). A duplicate sample was collected for physicochemical parameters at Sni-A-Bar station 4 during the spring period. Duplicate samples are analyzed and reported independently.

5.0 Results

5.1 Land Use

Land use data in Table 1 provides a comparison between the Sni-A-Bar Creek study reach 12-digit HUC and the Central Plains/Blackwater/Lamine EDU. All Sni-A-Bar Creek stations are located within the same 12-digit HUC.

Table 1
Percent Land Use in Sni-A-Bar Creek
Sampling Stations and the Central Plains/Blackwater/Lamine EDU

	12-digit HUC	Urban/Im-pervious	Crop-land	Grass-land	Forest-land	Herba-ceous	Wetland/ Open water
Sni-A-Bar Creek	103001010504	12.1	28.5	36.4	14.7	2.9	5.2
Central Plains/ Blackwater/Lamine EDU	--	8.0	38.2	31.5	15.9	2.1	4.4

Comparison of land use between the 12-digit HUC containing the study segments and the Central Plains/Blackwater/Lamine EDU showed the study stream contained more non-vegetated land and contained less cropland than the EDU. The percent of grassland, forestland, herbaceous coverage, and wetland/open water were similar between the EDU and the study stream watershed.

5.2 Stream Habitat Assessment

Habitat assessment scoring results are found in Table 2. If the study station SHAPP score is ≥75% of the control station score, the stations are considered to contain comparable habitats to the control station. Comparable habitats should support similar biological communities. All stations scored ≥75% of the SHAPP control, East Fork Crooked River. Based on SHAPP scores, it is inferred that the Sni-A-Bar Creek stations have habitats similar to the BIOREF stream and should, therefore, support a comparable biological community.

Table 2
Habitat Values and Scores from Stream Habitat Assessments
for Sni-A-Bar Creek and the East Fork Crooked River

Stream Habitat Parameters	Sni-A-Bar 1	Sni-A-Bar 2	Sni-A-Bar 3	Sni-A-Bar 4	East Fork Crooked R.
Habitat Assessment Date	9/17/2015	9/16/2015	9/17/2015	9/17/2015	9/17/2015
Epifaunal Substrate/Avail. Cover	IV (2)	III (7)	III (6)	IV (4)	IV (5)
Pool Substrate Characterization	III (10)	II (12)	II (12)	II (12)	II (15)
Pool Variability	II (14)	II (14)	II (13)	II (11)	II (15)
Sediment Deposition	I (18)	II (14)	I (18)	II (15)	I (18)
Channel Flow Status	II (15)	II (14)	II (12)	II (13)	I (16)
Channel Alteration	I (19)	I (20)	I (17)	I (18)	I (20)
Channel Sinuosity	III (6)	III (6)	III (7)	III (8)	III (6)
Left Bank Stability	I (9)	II (8)	II (8)	I (10)	II (8)
Right Bank Stability	II (6)	II (6)	II (8)	II (8)	I (9)
Left Bank Vegetative Protection	IV (0)	IV (1)	IV (0)	IV (0)	IV (0)
Right Bank Vegetative Protection	IV (0)	IV (0)	IV (0)	IV (0)	IV (0)
Left Bank Riparian Zone Width	III (4)	I (9)	I (9)	I (10)	III (4)
Right Bank Riparian Zone Width	IV (0)	I (9)	I (9)	I (10)	II (8)
Total Habitat Score	**103**	**120**	**119**	**119**	**124**

Habitat parameter categories range from I to IV with category I = optimal, category II = suboptimal, category III = marginal, and category IV = poor. Habitat parameter scores are listed in parentheses and range from 0 to 20 except for vegetative protection and riparian zone categories, which range from 0 to 10.

Sni-A-Bar Creek ranked poor in epifaunal substrate at stations 1 and 4 with marginal substrate available at the middle stations. The substrate was mostly mud or hard packed clay with steep banks. Little gravel and no cobble was present instream, and minimal rootmat was present. Woody debris was more prevalent among the upstream stations and also more prevalent during fall sampling. There were tires found instream and a fair amount of trash, mostly in the upstream stations. It appeared as though station 3 had historically been a trash dumping site at the road crossing. At the downstream terminus of station 3, the bank had been stabilized with large rectangular bricks along one side forming a wall approximately 15 feet high. Few shallow pools were present throughout the stream, and sediment deposition along bends and obstructions was highest at station

4. Channel flow status was suboptimal with water filling approximately 80 percent of the channel, and alterations were minimal through the study reach. Channel sinuosity was low at all study stations, only increasing the stream length by 1.5 times at most. Little active erosion was visible, and stream banks were considered moderately stable among all stations. Although vegetative protection along the banks was absent, the three upstream stations had well-established riparian corridors along both banks with a good mix of trees, understory growth, and grasses. Station 1 had minimal riparian corridor due to crop fields located on both sides of the stream.

East Fork Crooked River, the SHAPP control, also ranked low on epifaunal substrate. The substrate consisted mostly of soft sand, mud, and clay but also had pockets of gravel and more instream woody debris and rootmat. There was little sediment deposition evident and few shallow pools. Channel flow status ranked higher at the SHAPP control with water reaching the bases of the lower banks. There were no evident channel alterations and no tires or trash found instream. The sinuosity was low, similar to Sni-A-Bar Creek, with the length only increasing a minimal amount (1.1 times longer than if the stream was a straight line). The stream banks were considered stable with only infrequent areas of active erosion, and vegetative protection along the banks was absent. The riparian area along East Fork Crooked River was marginal due to crop fields and pasture land.

5.3 Biological Assessment and Macroinvertebrate Community Analyses

Tables 3 and 4 provide scoring criteria and results for the fall and spring index periods, respectively. MSCI scores were calculated by scoring study station biological metrics using the appropriate BIOREF criteria. An MSCI score of 16-20 is considered fully supporting, 10-14 is partially supporting, and 4-8 is considered non-supporting. Sni-A-Bar Creek had fully supporting MSCI scores at all four stations during both sampling seasons.

Table 3
Metric Values and Scores for Sni-A-Bar Creek Stations, Fall 2015,
Using Central Plains/Blackwater/Lamine Biological Criteria

Stations	TR	EPTT	BI	SDI	MSCI	Support
Sni-A-Bar 1	77	11	6.8	3.49		
Score	5	5	5	5	20	**Full**
Sni-A-Bar 2	66	11	6.7	3.15		
Score	5	5	5	5	20	**Full**
Sni-A-Bar 3	85	14	6.8	3.57		
Score	5	5	5	5	20	**Full**
Sni-A-Bar 4	60	7	6.9	3.11		
Score	5	5	5	5	20	**Full**
BIOREF Score=5	>55	>6	<7.6	>2.85	20-16	Full
BIOREF Score=3	55-27	6-3	7.6-8.8	2.85-1.43	14-10	Partial
BIOREF Score=1	<27	<3	>8.8	<1.43	8-4	Non

MSCI Scoring Table (in light gray) developed from BIOREF streams (*n* = 14). TR=Taxa Richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index.

Table 4
Metric Values and Scores for Sni-A-Bar Creek Stations, Spring 2016,
Using Central Plains/Blackwater/Lamine Biological Criteria

Stations	TR	EPTT	BI	SDI	MSCI	Support
Sni-A-Bar 1	72	8	6.7	3.12		
Score	5	3	5	5	18	**Full**
Sni-A-Bar 2	64	11	6.9	2.76		
Score	5	5	5	5	20	**Full**
Sni-A-Bar 3	67	9	6.4	2.8		
Score	5	5	5	5	20	**Full**
Sni-A-Bar 4	72	8	6.7	3.12		
Score	5	3	5	5	18	**Full**
BIOREF Score=5	>50	>8	<7.3	>2.53	20-16	Full
BIOREF Score=3	50-25	8-4	7.3-8.7	2.53-1.27	14-10	Partial
BIOREF Score=1	<25	<4	>8.7	<1.27	8-4	Non

MSCI Scoring Table (in light gray) developed from BIOREF streams (*n* = 12). TR=Taxa Richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index.

The fall 2015 macroinvertebrate community analysis is shown in Table 5. The total percentage of EPT taxa ranged from 13.4 percent to 36.7 percent (compared to the biological criteria reference average of 21.8 percent). Ephemeroptera and Trichoptera were present at each station. Plecoptera taxa were lacking from stations 2, 3, and 4 and composed only 0.1 percent of the taxa at station 1 (a single immature specimen in the family Leuctridae). By comparison, no stoneflies have occurred among the 14 Central

Plains/Blackwater/Lamine BIOREF fall samples used to calculate criteria. Dipteran taxa ranged from 34.9 percent to 65.1 percent, with Chironomidae being the most abundant family at all four stations. The Chironomidae taxa *Tanytarsus* and *Dicrotendipes* were commonly collected at all four stations. Elmidae and Baetidae ranked within the top five dominant families for all four stations. *Dubiraphia* and *Machronychus glabratus* were the commonly collected Elmidae taxa, and *Baetis* and *Acerpenna* were the commonly collected Baetidae taxa. Tubificidae was within the top five dominant families at stations 1, 2, and 4 and the sixth dominant family at station 3.

Table 5
Fall 2015 Macroinvertebrate Community Analysis

Stations / Variables	BIOREF Average	Sni-A-Bar 1	Sni-A-Bar 2	Sni-A-Bar 3	Sni-A-Bar 4
% Ephemeroptera	20.1	9.7	29.4	15.5	12.9
% Plecoptera	0.0	0.1	0.0	0.0	0.0
% Trichoptera	1.7	3.6	7.3	6.8	1.4
% Total EPT	21.8	13.4	36.7	22.3	14.3
% Diptera	41.8	49.0	34.9	45.5	65.1
% Dominant Macroinvertebrate Families					
Chironomidae	37.6	47.8	34.4	44.1	63.7
Elmidae	4.7	18.0	11.3	14.2	5.0
Coenagrionidae	3.0	4.9	1.0	4.1	0.6
Baetidae	0.5	4.8	20.8	10.3	9.7
Tubificidae	8.4	3.4	10.2	3.7	9.3
Hyalellidae	3.8	3.0	1.0	0.7	1.0
Heptageniidae	8.8	3.0	7.2	2.4	1.2
Caenidae	6.2	1.8	1.3	2.6	2.0
Hydropsychidae	0.1	1.0	4.2	4.0	1.4

The faded text indicates taxa not in the top five dominant taxa for the listed station.

During the fall, taxa in Sni-A-Bar Creek samples were fairly comparable to BIOREF streams in regards to sensitivity to organic pollution (Figure 4). In Sni-A-Bar Creek, taxa with BI values ≥5.0 (more tolerant) made up between 84 and 91.5 percent of samples. In comparison, the reference streams contained 93 percent of taxa within the same tolerance category. Taxa with BI values <5.0 (more sensitive) ranged from 8.5 percent to 16 percent of Sni-A-Bar Creek samples, compared to BIOREF streams in which the lower BI category composed an average of 7 percent of samples.

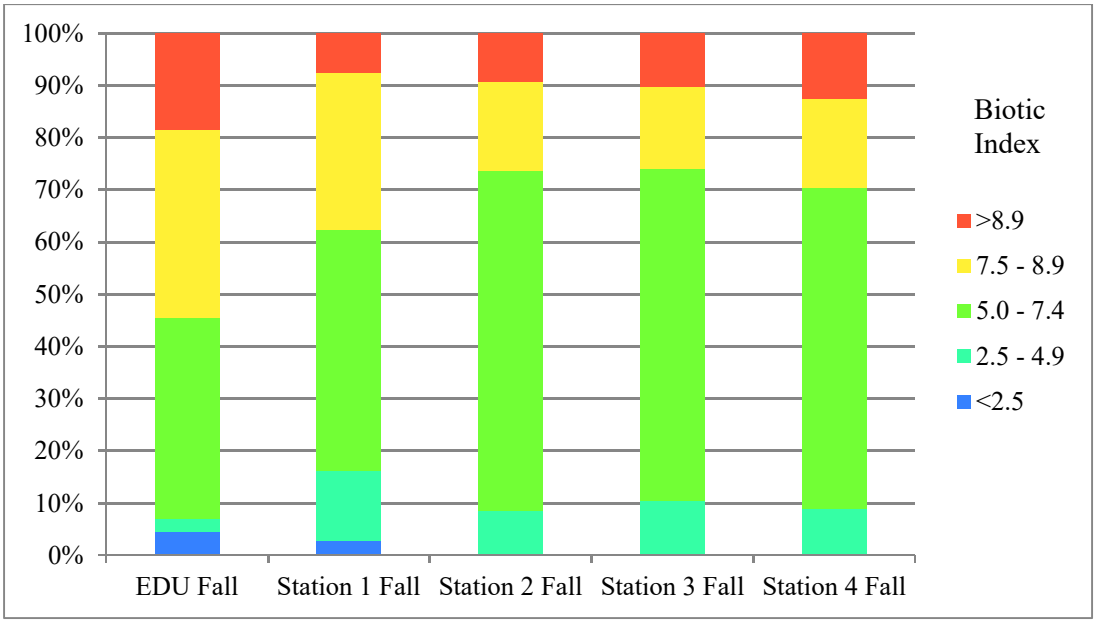

Figure 4. Fall 2015 Percent Taxa by Biotic Index Range

The spring 2016 macroinvertebrate community analysis is shown in Table 6. The total percentage of EPT taxa ranged from 2.7 to 11.7 percent among the study stations and made up 10.3 percent of the biological community among BIOREF samples. Ephemeroptera and Trichoptera were less abundant during the spring sampling season. Plecoptera were present at two of the four stations during the spring sampling. Dipteran taxa were present in higher numbers, making up from 82.6 percent to 90.4 percent of samples. As in the fall, Chironomidae was the dominant family with *Tanytarsus* and *Cricotopus/Orthocladius* composing at least 35 percent of the total of all taxa collected at each of the four Sni-A-Bar Creek stations.

Table 6
Spring 2016 Macroinvertebrate Community Analysis

Stations / Variables	BIOREF Average	Sni-A-Bar 1	Sni-A-Bar 2	Sni-A-Bar 3	Sni-A-Bar 4
% Ephemeroptera	7.9	2.4	3.2	11.0	7.9
% Plecoptera	1.3	0.0	0.0	0.3	0.1
% Trichoptera	1.1	0.3	0.8	0.4	0.6
% Total EPT	10.3	2.7	4.0	11.7	8.6
% Diptera	62.3	90.4	87.5	82.6	83.0
% Dominant Macroinvertebrate Families					
Chironomidae	54.4	88.0	86.4	73.5	79.4
Ceratopogonidae	1.9	2.1	0.7	0.7	0.5
Hyalellidae	2.3	1.4	<0.1	<0.1	0.5
Elmidae	0.4	1.3	1.3	1.4	2.3
Baetidae	1.4	1.1	2.0	9.7	4.5
Tubificidae	10.3	1.0	5.2	1.8	1.2
Caenidae	3.2	0.9	0.6	1.0	2.3
Heptageniidae	2.2	0.4	0.6	0.2	1.2
Asellidae	6.6	0.4	0.2	<0.1	0.3
Simuliidae	5.0	0.0	0.3	8.1	1.7

The faded text indicates taxa not in the top five dominant taxa for the listed station.

As in the fall, taxa of Sni-A-Bar Creek spring samples were similar in organic pollution tolerance levels compared to BIOREF streams (Figure 5). The percentage of taxa with BI values ≥5.0 was slightly higher in Sni-A-Bar Creek than the reference streams with the exception of Sni-A-Bar station 3, which was comparable to the reference streams. Station 3 had 87 percent of taxa with BI values ≥5.0, whereas reference streams had 89 percent of taxa within the same BI range. The remainder of the Sni-A-Bar Creek stations had approximately 95 percent of taxa with BI values ≥5.0. The same pattern exists with the lower BI category. Sni-A-Bar Creek station 3 had 13 percent in the <5.0 BI range, and reference streams had 11 percent in this range. The remaining Sni-A-Bar Creek stations had 5.6 percent or less in the lower BI value range.

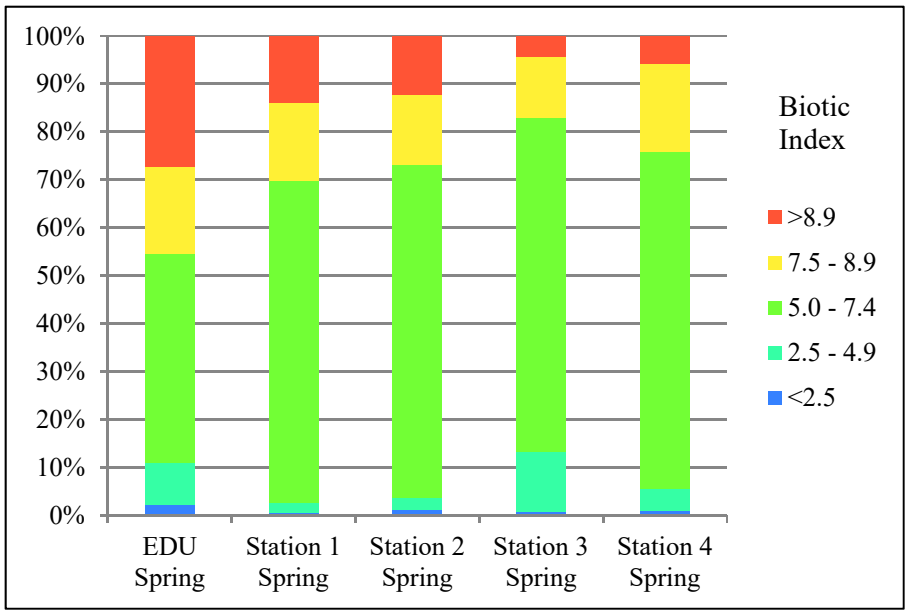

Figure 5. Spring 2016 Percent Taxa by Biotic Index Range

5.4 Physicochemical Water Parameters

Discharge and *in situ* results are presented in Tables 7 and 8. Physicochemical values were fairly consistent throughout the watershed for each season. Most of the *in situ* water quality parameters analyzed for this study were not elevated during either season with the exception of turbidity values during fall sampling.

Dissolved oxygen levels ranged from 6.55 mg/L to 8.09 mg/L during the fall sampling period. Turbidity values appeared elevated, but values were consistent among the four stations. Discharge was lowest at the most upstream station. At the downstream station, the creek appears to have a diversion channel or an abandoned stream channel on the south side of the creek. This secondary channel did not appear, however, to divert flow away from Sni-A-Bar Creek.

Table 7
Fall 2015 Discharge and *In Situ* Water Quality Measurements

Stations / Parameters	Sni-A-Bar 1	Sni-A-Bar 2	Sni-A-Bar 3	Sni-A-Bar 4
Sampling time and date	1050h 9/17	1405h 9/16	1030h 9/16	1225h 9/16
Dissolved Oxygen (mg/L)	6.55	8.09	6.82	7.06
pH (su)	8.1	7.9	7.8	7.9
Specific Conductance (µS/cm)	577	590	606	517
Temperature (°C)	22.9	23.6	21.1	21.5
Turbidity (NTU)	15	14	14	16
Discharge (cfs)	10.4	13.9	13.1	8.5

During the spring sampling season, dissolved oxygen levels ranged from 10.98 mg/L to 15.17 mg/L. Turbidity was lower during the spring season. Discharge measurements ranged from 14.1 cfs to 25.5 cfs during the spring and followed the same pattern as the fall sampling period by decreasing at the most upstream station.

Table 8
Spring 2016 Discharge and *In Situ* Water Quality Measurements

Stations / Parameters	Sni-A-Bar 1	Sni-A-Bar 2	Sni-A-Bar 3	Sni-A-Bar 4a	Sni-A-Bar 4b
Sampling time and date	1430h 3/22	1320h 3/22	1155h 3/22	1027h 3/22	1030h 3/22
Dissolved Oxygen (mg/L)	13.61	15.17	10.98	11.25	11.23
pH (su)	8.7	8.7	8.4	8.6	8.3
Specific Conductance (µS/cm)	610	612	631	557	558
Temperature (°C)	11.1	11.6	10.9	8.4	8.4
Turbidity (NTU)	4.5	3.6	3.9	4.7	4.0
Discharge (cfs)	20.8	18.8	25.5	14.1	14.3

There are currently no nutrient criteria in place for Missouri streams and rivers. The values for each season were compared to the United States Environmental Protection Agency's (**USEPA**) December 2000 Ambient Water Quality Criteria Recommendations for Rivers and Streams in Nutrient Ecoregion IX (USEPA 2000). USEPA's recommended values for the Central Irregular Plains are as follows: 0.23 mg/L nitrate + nitrite; 0.71 mg/L total nitrogen; 0.09 mg/L total phosphorus; and 15.5 NTU turbidity (turbidity values are reported in the *in situ* tables above). Water chemistry concentrations are presented in Tables 9 and 10.

During the fall sampling season, nitrate+nitrite, total nitrogen, and total phosphorus were elevated at all sampling stations compared to USEPA recommended concentrations. Although concentrations of these nutrient parameters were noticeably elevated at the stations downstream of the WWTF, they were only slightly elevated upstream of the WWTF. Ammonia as N, sulfate, and chloride were within acceptable concentration ranges based on the Missouri WQS (MoDNR 2014).

Table 9
Fall 2015 Water Chemistry Concentrations

Stations / Parameters	Sni-A-Bar 1	Sni-A-Bar 2	Sni-A-Bar 3	Sni-A-Bar 4
Sampling time and date	1050h 9/17	1405h 9/16	1030h 9/16	1225h 9/16
Nitrate+Nitrite as N (mg/L)	1.83	2.60*	2.18*	0.5
Total Nitrogen (mg/L)	2.45	3.14	2.54	0.91
Total Phosphorus (mg/L)	0.98	1.20	1.09	0.12
Ammonia as N (mg/L)	0.13	0.11	0.09	0.06
Sulfate (mg/L)	52.3	54.7	54.0	31.0
Chloride (mg/L)	50.7	50.1	54.1	40.2
Total Suspended Solids (mg/L)	28.0	20.0	22.0	17.0

* Sample was diluted during analysis

During the spring sampling season, nitrate+nitrite, total nitrogen, and total phosphorus were elevated at the sampling stations downstream of the WWTF. As was the case with fall samples, ammonia as N, sulfate, and chloride were within acceptable concentrations based on the Missouri WQS (MoDNR 2014).

Table 10
Spring 2016 Water Chemistry Concentrations

Stations / Parameters	Sni-A-Bar 1	Sni-A-Bar 2	Sni-A-Bar 3	Sni-A-Bar 4a	Sni-A-Bar 4b
Sampling time and date	1430h 3/22	1320h 3/22	1155h 3/22	1027h 3/22	1030h 3/22
Nitrate+Nitrite as N (mg/L)	1.52	1.96	2.13*	<0.008 ND	<0.008 ND
Total Nitrogen (mg/L)	1.96	2.50	2.63	0.20	0.19+
Total Phosphorus (mg/L)	0.64	0.79	0.92	0.039+	0.036+
Ammonia as N (mg/L)	0.49+	0.093	0.034+	<0.03 ND	<0.03 ND
Sulfate (mg/L)	66.9	71.3	75.1	52.6	52.4
Chloride (mg/L)	55.1	56.8	58.3	43.3	44.2
Total Suspended Solids (mg/L)	6.0§	6.0§	6.0§	7.0§	6.0§

* Sample was diluted during analysis
\+ Estimated Value, detected below Practical Quantitation Limits
§ Estimated Value, QC data outside limits
ND not detected at reported value

6.0 Discussion

6.1 Land Use

Sni-A-Bar Creek originates in eastern Jackson County, Missouri, and is a tributary of the Missouri River. This study area focused on the upper watershed, approximately 20 miles upstream of the confluence with the Missouri River. According to the Jackson County official website, the county includes most of Kansas City along with several other communities and contains approximately 650,000 people (Jackson County Official Website; About Us: http://www.jacksongov.org/31/About-Us) . The watershed for the

study stream comprises mostly grassland (36.4 percent) and cropland (28.5 percent) and contained a higher percentage of urban/impervious than the EDU. With having proximity close to Kansas City and its suburbs (as well as Interstate 70), the area is highly populated with both commercial properties and residential properties. The watershed of the EDU is a more rural setting and contains more cropland (38.2 percent) than the watershed of the study stream (28.5 percent).

Limiting watersheds to 10 percent impervious surfaces has been suggested as an applicable criterion level considered protective of stream ecosystems (Cuffney et al 2010, Klein 1979). The urban\impervious land use of Sni-A-Bar watershed was just above that threshold at 12 percent. Cuffney et al. (2010) concluded the conversion of agriculture land (versus forests or shrubland) had less significant effects on macroinvertebrate communities because the agricultural land has already negatively affected the aquatic communities. Agricultural cropland made up nearly 40 percent of the Central Plains/Blackwater/Lamine EDU, and the biological criteria reference stream watersheds used to establish criteria and calculate MSCI scores ranged from 19 to 30 percent cropland. It is likely the macroinvertebrate community in both the EDU and Sni-A-Bar Creek have adapted to the effects of landscape alterations that occurred several decades ago with the conversion to agricultural lands (Cuffney et al. 2010, Harding et al. 1998).

6.2 Stream Habitat Assessment

The SHAPP scores for all four Sni-A-Bar Creek stations were >75% of the score for East Fork Crooked River, the SHAPP control stream. Sni-A-Bar Creek epifaunal substrate consisted mostly of woody debris and a notable amount of trash and tires. Sediment deposition was present throughout the stream reach but did not appear to be excessive. Vegetative protection of the banks was sparse or absent at each station as well as at the control site, likely due to nature of the stream system, which has steep banks made up of fine mud, silt, and clay. Riparian areas were well established at the three upstream stations but marginal at the downstream station due to adjacent crop fields. The habitat assessment indicated the study reach is similar to the biological criteria reference stream conditions for the Central Plains/Blackwater/Lamine EDU and should support a similar macroinvertebrate community.

6.3 Biological Assessment and Macroinvertebrate Community Analysis

Based on Central Plains/Blackwater/Lamine EDU BIOREF data, all stations attained MSCI scores in the fully supporting range (score of 16-20) for both the fall and spring sampling seasons. All four stations attained the highest possible MSCI score of 20 during the fall season. During the spring, stations 1 and 4 attained fully supporting status but had suboptimal EPTT values, which resulted in MSCI scores of 18. The presence of a single additional EPT taxon at stations 1 and 4 during the spring would have elevated the EPTT metric into the optimal category, and both stations would have attained MSCI scores of 20.

During the fall, macroinvertebrate abundance varied. According to the SMSBPP, laboratory subsampling will continue until the target number of specimens is reached (300 for each habitat in this study) or 50 percent of the sample is processed, whichever comes first (MoDNR 2012). Some Sni-A-Bar Creek habitats required 50 percent of the sample to be subsampled, whereas other habitats required much less. Both the non-flow and woody debris habitats at station 1 required 50 percent of the habitat to be subsampled. At station 4, only 15 percent of the non-flow was sampled to reach the target number. Macroinvertebrate abundance was higher during the spring. The highest percentage subsampled was approximately 17 percent.

Though no live zebra mussels (*Dreissena polymorpha*) were collected during macroinvertebrate sampling, shells of dead individuals were seen along the stream banks. According to a Missouri Department of Conservation (**MDC**) news release (https://mdc.mo.gov/newsroom/mdc-confirms-zebra-mussels-three-jackson-county-lakes), zebra mussels have been reported in Lake Lotawana located in the Sni-A-Bar Creek watershed. Zebra mussels are an invasive aquatic species that can negatively affect aquatic communities of the waters they inhabit. MDC has established measures to help prevent the spread of zebra mussels in Missouri waterways (see previously mentioned news release for more information).

6.4 Physicochemical Water Parameters

In situ physicochemical water quality measurements were fairly consistent for each sampling season. Although Sni-A-Bar Creek is currently on the 303(d) list of impaired waters for low dissolved oxygen from an unknown source, the dissolved oxygen levels were above the Water Quality Standards' minimum criteria of 5.0 mg/L during both sampling periods. Turbidity appeared slightly elevated during the fall sampling season, but the values were consistent throughout the sampling reach.

One notable trend in the water chemistry concentrations was the elevated nitrate+nitrite, total nitrogen, and total phosphorus, particularly downstream of the WWTF during both sampling seasons. During the fall, all four stations had elevated nutrients (the values were only slightly elevated upstream of the WWTF). Downstream of the WWTF, nitrate+nitrite values ranged from eight times higher than USEPA's recommended criteria to 11 times higher, total nitrogen was as much as 4.4 times higher than USEPA's recommended values, and total phosphorus values were at least 10 times higher. The values upstream of the treatment plant were one to two times higher than the recommended criteria. During the spring, only the stations downstream of the WWTF had elevated nutrients. Nitrate+nitrite was at least six times higher than the recommended concentration. Total nitrogen was three to four times higher, and total phosphorus was up to 10 times higher than the recommended values proposed by USEPA. By comparison, station 4 upstream of the WWTF had nitrate+nitrite, total nitrogen, and total phosphorus concentrations that were either below laboratory detection limits or near Practical Quantitation Levels used by CAS.

Excessive nutrients can potentially threaten aquatic communities by causing algal blooms and eutrophication. However, there were no signs of negative effects to the community through eutrophication at Sni-A-Bar Creek. Algae were present throughout the stream but did not appear to be excessive at any of the stations, perhaps due to the water being turbid enough to hinder photosynthesis by algae.

7.0 Summary

Five null hypotheses were stated in the introduction: 1) land cover characteristics in the Sni-A-Bar Creek watershed will be similar to the land cover characteristics of the Central Plains/Blackwater/Lamine EDU; 2) stream habitat assessment scores of Sni-A-Bar Creek will be similar to those of East Fork Crooked River (the BIOREF control stream); 3) the macroinvertebrate community in Sni-A-Bar Creek will be similar among longitudinally separate reaches of Sni-A-Bar Creek; 4) the macroinvertebrate community in Sni-A-Bar Creek will be similar to the macroinvertebrate community of BIOREF streams in the Central Plains/Blackwater/Lamine EDU; 5) Physicochemical water quality of Sni-A-Bar Creek will meet the Missouri WQS (MoDNR 2014).

Null hypothesis #1 is accepted. The land use comparison between the 12-digit HUC and the Central Plains/Blackwater/Lamine showed similar land use characteristics between the two. The Sni-A-Bar Creek watershed did, however, have a slightly higher percentage of urban/impervious land use than the 12-digit HUC.

Null hypothesis #2 is accepted. The SHAPP scores of the study stations all scored >75% of the SHAPP control stream. As the SHAPP scores imply, the habitat quality of Sni-A-Bar Creek is comparable to the biological criteria reference station on East Fork Crooked River.

Null hypothesis #3 is accepted. All four stations scored fully biologically supporting during both seasons, and the dominant taxa at Sni-A-Bar Creek were similar among stations. Minor differences were present presumably due to stream gradient.

Null hypothesis #4 is accepted. Reference streams within the EDU represent the best available conditions and are the basis for calculating MSCI scores. All four stations attained fully supporting MSCI scores during both seasons, indicating that Sni-A-Bar Creek has a similar macroinvertebrate community compared to Central Plains/Blackwater/Lamine EDU biological criteria reference streams.

Null hypothesis #5 is accepted. All water chemistry parameters were within the limits established by the WQS. However, not all parameters tested have established criteria in the WQS. Missouri currently does not have established criteria for nutrients in streams and rivers. Nitrate+nitrite, total nitrogen, and total phosphorus were elevated when compared with USEPA's recommended values for the Central Irregular Plains.

8.0 Conclusion

The MSCI scores of all four stations during both sampling seasons scored ≥18, indicating that the survey reach fully supports the protection of warm water aquatic life beneficial use designation. Instream habitat for Sni-A-Bar Creek study stations was similar to reference stream conditions, and resulting habitat scores were considered comparable to the BIOREF station. Woody debris and submerged rootmat were present instream as refugia for macroinvertebrates. Stream banks were stable with ample riparian habitat (with the exception of station 1). The macroinvertebrate community makeup was similar to BIOREF streams, and similar taxa were present at all four stations. Sni-A-Bar Creek tended to have a macroinvertebrate community with organic pollution tolerance levels similar to BIOREF conditions. Water quality measurements revealed nothing notable with the exception of high nutrient levels downstream of the WWTF. However these nutrient concentrations did not appear to negatively affect the macroinvertebrate community.

Though the bioassessment of Sni-A-Bar Creek suggests no biological impairment, the creek is noncompliant with state narrative criteria, which prohibit used tires, car bodies, appliances, demolition debris, used vehicles and equipment, and any solid waste in water bodies of the State of Missouri (MoDNR 2014). Tires were presesent throughout the stream reach but were especially numerous in the upstream stations, which are located near a historic tire cleanup site (MoDNR 2016k). Station 3 appeared to have historically been a dump site of solid waste. Dump sites not only create a public nuisance but can also cause health issues by attracting rodents and pests and cause environmental contamination to streams, rivers, groundwater, and wells. It was apparent through sedimentation around the trash that this site had historically been used as a dump site and had not been used as such recently.

9.0 Literature Cited

Cuffney, T. F., R. A. Brightbill, J. T. May and I. R. Waite. 2010. Responses of benthic macroinvertebrates to environmental changes association with urbanization in nine metropolitan areas. Ecological Applications. 20(5): 1384-1401.

Harding, J. S., E.F. Benfield, P. V. Bolstad, G.S. Helfman, and E. B. D. Jones III. 1998. Stream Biodiversity: The ghost of land use past. Proceeding of the National Academy of Sciences, USA. 95: 14843-14847.

Jackson County Official Website; About Us: http://www.jacksongov.org/31/About-Us Accessed October 2017

Klein, R. D. 1979. Urbanization and Stream Quality Impairment. Water Resources Bulletin, American Water Resources Association. 15: 948-963.

Missouri Department of Conservation. July 24, 2017 News Release: https://mdc.mo.gov/newsroom/mdc-confirms-zebra-mussels-three-jackson-county-lakes

MoDNR. 2012 Semi-Quantitative Macroinvertebrate Stream Bioassessment Project Procedure. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 29 pp.

MoDNR. 2013. Standard Operating Procedure MDNR-ESP-210: Quality Assurance/Quality Control for Environmental Data Collection. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 13 pp.

MoDNR. 2014. Title 10. Rules of Department of Natural Resources Division 20-Clean Water Commission, Chapter 7-Water Quality. 10 CSR 20-7.031 Water Quality Standards. pp. 12-149.

MoDNR. 2015. Standard Operating Procedure MDNR-ESP-113: Flow Measurements in Open Channels. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 13 pp.

MoDNR. 2016a. Standard Operating Procedure MDNR-ESP-012: Analysis of Turbidity Using the Hach 2100P and 2100Q Portable Turbidmeter. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 9 pp.

MoDNR. 2016b. Standard Operating Procedure MDNR-ESP-103: Field Analysis of Dissolved Oxygen Using Meters. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 16 pp.

MoDNR. 2016c. Standard Operating Procedure MDNR-ESP-102: Field Analysis of Specific Conductance in Water. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 9 pp.

MoDNR. 2016d. Standard Operating Procedure MDNR-ESP-100: Field Analysis of Water Samples for pH. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 8 pp.

MoDNR. 2016e. Standard Operating Procedure MDNR-ESP-101: Field Measurement of Water Temperature. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 3 pp.

MoDNR. 2016f. Standard Operating Procedure MDNR-ESP-213: Quality Control Procedures for Checking Water Quality Field Instruments. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 13 pp.

MoDNR. 2016g. Standard Operating Procedure MDNR-ESP-214: Quality Control Procedures for Data Processing. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 7 pp.

MoDNR. 2016h. Standard Operating Procedure MDNR-ESP-001: Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 24 pp.

MoDNR. 2016i. Stream Habitat Assessment Project Procedure. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 40 pp.

MoDNR. 2016j. MDNR-ESP-209: Taxonomic Levels for Macroinvertebrate Identifications. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 38 pp.

MoDNR 2016k. Scrap Tire and Illegal Dumping Unit. https://dnr.mo.gov/env/swmp/tires/tirelist.htm

Sowa, S.P., D.D. Diamond, R.A. Abbitt, G.M. Annis, T. Gordon, M.E. Morey, G.R. Sorensen, and D. True. 2004. Final Report of the Aquatic Component of GAP Analysis: A Missouri Prototype. Missouri Resource Assessment Partnership (MoRAP), University of Missouri. 111 pp.

USEPA. 2000. Ambient Water Quality Criteria Recommendations. Information Supporting the Development of State and Tribal Nutrient Criteria for River and

Streams in Nutrient Ecoregion IX. United States Environmental Protection Agency, Office of Water, Washington, D.C., EPA-822-B-00-019. 32 pp.

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Appendix A

Invertebrate Database Bench Sheet Report Fall 2015 and Spring 2016;
Sni-A-Bar Creek Creek, Jackson Co, MO
Grouped by Season and Station

Aquid Invertebrate Database Bench Sheet Report
Sni-A-Bar Cr [15132], Station #1, Sample Date: 9/17/2015 12:25:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	3	1	1
AMPHIPODA			
Hyalella azteca	2	26	
BASOMMATOPHORA			
Ancylidae			1
Lymnaeidae		1	
Menetus	1		
Physella	3	7	1
COLEOPTERA			
Dubiraphia	31	30	4
Macronychus glabratus	5	28	64
Neoporus		9	2
Peltodytes		1	
Stenelmis	2	2	2
DECAPODA			
Faxonius virilis		1	-99
Palaemonetes kadiakensis		2	
DIPTERA			
Ablabesmyia	15	6	1
Ceratopogoninae	5	2	
Chironomidae	1	3	1
Chironomus	1		
Cladotanytarsus	2		
Corynoneura	2		
Cricotopus/Orthocladius		5	1
Cryptochironomus	13	2	
Cryptotendipes	10	1	
Dicrotendipes	16	13	24
Forcipomyiinae			2
Harnischia	3		
Helius			1
Labrundinia	1	2	
Limnophila		1	
Mesosmittia	2		
Nanocladius	2	1	
Paralauterborniella	49	1	
Paratanytarsus	1	2	
Phaenopsectra	1		
Polypedilum flavum	6	19	10
Polypedilum illinoense grp	3	9	3

Aquid Invertebrate Database Bench Sheet Report
Sni-A-Bar Cr [15132], Station #1, Sample Date: 9/17/2015 12:25:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Polypedilum scalaenum grp	54	1	3
Procladius	3	1	
Pseudochironomus	2		
Rheotanytarsus	4	11	2
Stelechomyia			5
Stempellina	2		1
Stempellinella	4		
Stenochironomus		1	4
Tanytarsus	24	44	24
Thienemannimyia grp.		7	3
Tribelos			14
Zavrelimyia		1	
EPHEMEROPTERA			
Acerpenna		6	5
Baetis		5	22
Caenis latipennis	7	9	1
Centroptilum	7		
Hexagenia limbata	1		
Stenacron	5	9	14
HEMIPTERA			
Belostoma		-99	
Corixidae	1		1
Rheumatobates	1	2	
ISOPODA			
Lirceus	1		
LUMBRICINA			
Lumbricina	1		
ODONATA			
Argia	7	23	9
Boyeria			-99
Calopteryx		6	
Hetaerina		1	
Ischnura	1	6	
Libellulidae		1	
PLECOPTERA			
Leuctridae	1		
RHYNCHOBDELLIDA			
Piscicolidae	1		
TRICHOPTERA			
Cheumatopsyche		3	1

Aquid Invertebrate Database Bench Sheet Report
Sni-A-Bar Cr [15132], Station #1, Sample Date: 9/17/2015 12:25:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Hydropsyche		2	3
Neotrichia	4	11	7
Oecetis	2		1
TRICLADIDA			
Planariidae			1
TUBIFICIDA			
Branchiura sowerbyi	1		1
Enchytraeidae	1		
Limnodrilus claparedianus	2		
Tubificidae	24	1	3
VENEROIDA			
Corbicula	18	1	5
Pisidiidae			1

Aquid Invertebrate Database Bench Sheet Report
Sni-A-Bar Cr [15131], Station #2, Sample Date: 9/16/2015 3:00:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
AMPHIPODA			
Crangonyx	1		
Hyalella azteca		10	
ARHYNCHOBDELLIDA			
Erpobdellidae	-99		
BASOMMATOPHORA			
Ancylidae		1	
COLEOPTERA			
Dubiraphia	29	20	
Helichus basalis		2	
Macronychus glabratus	11	15	33
Neoporus		3	
Stenelmis	4	2	3
DECAPODA			
Faxonius virilis	1		
Palaemonetes kadiakensis		-99	
DIPTERA			
Ablabesmyia	12	4	2
Corynoneura	2	1	
Cricotopus/Orthocladius		2	2
Cryptochironomus	11	2	
Cryptotendipes	1		
Dicrotendipes	19	6	18
Dolichopodidae	1		
Forcipomyiinae			4
Nanocladius	1	3	
Nilotanypus		1	
Parakiefferiella	1		
Paralauterborniella	30		
Paratanytarsus		4	1
Phaenopsectra	2		1
Polypedilum fallax grp			1
Polypedilum flavum	17	33	7
Polypedilum illinoense grp		2	1
Polypedilum scalaenum grp	18	1	2
Procladius	2		
Rheotanytarsus	2	35	7
Stelechomyia			3
Stenochironomus	2		2
Tanypus	1		
Tanytarsus	16	43	18

Aquid Invertebrate Database Bench Sheet Report
Sni-A-Bar Cr [15131], Station #2, Sample Date: 9/16/2015 3:00:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Thienemanniella		2	
Thienemannimyia grp.	4	10	2
Tribelos	1		
EPHEMEROPTERA			
Acerpenna	2	6	1
Baetis	3	22	180
Caenis latipennis	6	7	
Fallceon		1	1
Stenacron	28	7	40
Tricorythodes		2	
HEMIPTERA			
Microvelia		1	1
Rheumatobates			1
ISOPODA			
Caecidotea	1	2	1
LUMBRICULIDA			
Lumbriculidae	1		
ODONATA			
Argia	1	8	1
Basiaeschna janata		-99	
Calopteryx	1	17	
Erythemis		-99	
Hagenius brevistylus	-99		
Hetaerina		2	
Nasiaeschna pentacantha		1	
TRICHOPTERA			
Cheumatopsyche		12	17
Hydropsyche	1	5	9
Hydroptila		9	
Nectopsyche		1	
Oecetis		22	
TUBIFICIDA			
Branchiura sowerbyi	16		
Limnodrilus claparedianus	3	1	
Limnodrilus hoffmeisteri	2		
Tubificidae	81	2	1
VENEROIDA			
Corbicula	1		1
Pisidiidae	6	5	2

Aquid Invertebrate Database Bench Sheet Report
Sni-A-Bar Cr [15130], Station #3, Sample Date: 9/16/2015 11:30:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	4		
AMPHIPODA			
Crangonyx		1	
Hyalella azteca		7	
ARHYNCHOBDELLIDA			
Erpobdellidae	-99		
BASOMMATOPHORA			
Ancylidae	1	2	
Physella	1	25	
BRANCHIOBDELLIDA			
Branchiobdellida	7		
COLEOPTERA			
Dubiraphia	49	46	3
Macronychus glabratus	3	8	30
Neoporus		8	
Scirtidae		2	
Stenelmis	9	3	1
DECAPODA			
Faxonius virilis	2	-99	-99
DIPTERA			
Ablabesmyia	35	15	
Ceratopogoninae	3		
Cladotanytarsus	1		
Corynoneura	2		
Cricotopus bicinctus		2	
Cricotopus/Orthocladius		2	5
Cryptochironomus	7		4
Cryptotendipes	8		
Dicrotendipes	16	3	42
Diptera	1		
Dolichopodidae	1		
Forcipomyiinae		1	3
Glyptotendipes			2
Gonomyia	1		
Labrundinia	1		
Larsia		4	
Mesosmittia		1	
Nanocladius		4	2
Nilotanypus	1	2	
Parachironomus		7	

Aquid Invertebrate Database Bench Sheet Report
Sni-A-Bar Cr [15130], Station #3, Sample Date: 9/16/2015 11:30:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Paracladopelma	20		
Paratendipes	1	1	
Pentaneura		1	
Phaenopsectra	1		
Polypedilum fallax grp	1		
Polypedilum flavum	17	6	8
Polypedilum halterale grp		1	
Polypedilum illinoense grp	2	6	4
Polypedilum scalaenum grp	5	3	1
Procladius	2		
Pseudochironomus			2
Rheotanytarsus	2	3	11
Saetheria	1	1	
Simulium			2
Stelechomyia			5
Stempellinella	1		
Stenochironomus	2		12
Tanytarsus	29	78	41
Thienemanniella	1	1	1
Thienemannimyia grp.	4	12	6
Tipula		1	1
Tribelos			5
Tvetenia bavarica grp	1		
Zavrelimyia		6	
EPHEMEROPTERA			
Acerpenna	2	1	23
Baetis	1		36
Caenis latipennis	20	7	1
Fallceon	2	4	26
Procloeon	11		4
Stenacron	11	5	9
Stenonema femoratum			1
Tricorythodes			1
ISOPODA			
Caecidotea	1	4	
Caecidotea (Blind & Unpigmented)	1		
LUMBRICULIDA			
Lumbriculidae	1		
ODONATA			
Argia	3	25	1

Aquid Invertebrate Database Bench Sheet Report
Sni-A-Bar Cr [15130], Station #3, Sample Date: 9/16/2015 11:30:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Boyeria		-99	
Calopteryx		4	
Enallagma	1	14	
Hetaerina		1	2
Nasiaeschna pentacantha			1
TRICHOPTERA			
Cheumatopsyche	6		30
Hydropsyche		1	6
Hydroptila	1	16	4
Nectopsyche		1	
Oecetis	7		
Polycentropodidae	1		
TRICLADIDA			
Planariidae		1	
TUBIFICIDA			
Enchytraeidae	1		
Limnodrilus hoffmeisteri	4		
Tubificidae	29	5	1
VENEROIDA			
Pisidiidae	27	3	2

Aquid Invertebrate Database Bench Sheet Report
Sni-A-Bar Cr [15129], Station #4, Sample Date: 9/16/2015 1:20:00 PM
NF = Nonflow; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	SG
"HYDRACARINA"		
Acarina	4	
AMPHIPODA		
Hyalella azteca		5
ARHYNCHOBDELLIDA		
Erpobdellidae	2	
BASOMMATOPHORA		
Physella	1	2
COLEOPTERA		
Dubiraphia	7	2
Macronychus glabratus		3
Scirtidae		2
Stenelmis	12	1
DECAPODA		
Faxonius virilis	-99	
DIPTERA		
Ablabesmyia	16	2
Ceratopogoninae	2	
Chironomidae	1	
Chironomus	2	
Cladotanytarsus	5	1
Corynoneura		1
Cryptochironomus	5	
Cryptotendipes	2	1
Dicrotendipes	3	27
Dolichopodidae		1
Ephydridae	2	1
Forcipomyiinae		1
Microtendipes	2	
Nanocladius	1	3
Natarsia		1
Paracladopelma	6	
Paratendipes	3	
Polypedilum fallax grp		2
Polypedilum flavum		2
Polypedilum illinoense grp	3	5
Polypedilum scalaenum grp	22	7
Pseudochironomus	5	2
Rheocricotopus		1
Rheotanytarsus	1	16
Saetheria	3	

Aquid Invertebrate Database Bench Sheet Report
Sni-A-Bar Cr [15129], Station #4, Sample Date: 9/16/2015 1:20:00 PM
NF = Nonflow; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	SG
Stelechomyia		1
Stempellinella	1	
Stenochironomus		6
Stictochironomus	2	
Tanytarsus	48	84
Thienemannimyia grp.	2	12
Tribelos		9
EPHEMEROPTERA		
Acerpenna		20
Baetis	1	19
Caenis latipennis	7	3
Procloeon	3	5
Stenacron	5	
Stenonema femoratum		1
HEMIPTERA		
Microvelia		1
ISOPODA		
Caecidotea (Blind & Unpigmented)	1	
ODONATA		
Argia		2
Calopteryx	1	-99
Enallagma		1
Hetaerina	1	
TRICHOPTERA		
Cheumatopsyche		7
TUBIFICIDA		
Enchytraeidae		1
Limnodrilus claparedianus	1	
Limnodrilus hoffmeisteri	1	
Tubificidae	44	
VENEROIDA		
Corbicula	1	
Pisidiidae	6	

Aquid Invertebrate Database Bench Sheet Report
Sni-A-Bar Cr [16069], Station #1, Sample Date: 3/22/2016 2:30:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	1	1	
AMPHIPODA			
Crangonyx	2	7	
Hyalella azteca		14	2
ARHYNCHOBDELLIDA			
Erpobdellidae	1		
BASOMMATOPHORA			
Lymnaeidae		1	
Physella	1	5	1
COLEOPTERA			
Dubiraphia	1	6	1
Dytiscidae	1		
Macronychus glabratus		5	2
Scirtidae		2	
DECAPODA			
Faxonius virilis	-99	-99	1
Palaemonetes kadiakensis		-99	
DIPTERA			
Ablabesmyia	14	10	13
Ceratopogoninae	7	14	2
Chironomidae	3	2	
Chironomus	5	1	
Cladotanytarsus	2	2	
Cricotopus/Orthocladius	57	88	45
Cryptochironomus	9		6
Cryptotendipes	20	1	1
Dicrotendipes	15	6	28
Diptera		1	1
Hydrobaenus	26	7	4
Labrundinia		4	
Micropsectra		1	
Nanocladius		5	
Natarsia	1		
Paracladopelma	3		
Parakiefferiella	6	1	
Paralauterborniella	46	13	2
Paraphaenocladius			1
Paratanytarsus		3	
Paratendipes	4	1	3
Phaenopsectra	2	24	57

Aquid Invertebrate Database Bench Sheet Report
Sni-A-Bar Cr [16069], Station #1, Sample Date: 3/22/2016 2:30:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Polypedilum fallax grp		1	46
Polypedilum flavum	1	11	1
Polypedilum halterale grp	1		
Polypedilum illinoense grp	1	46	40
Polypedilum scalaenum grp	13	2	4
Rheocricotopus		1	
Rheotanytarsus	5	7	8
Stempellina	1		
Tabanus		2	
Tanytarsus	52	74	89
Thienemanniella		2	
Thienemannimyia grp.	3	10	21
Zavrelimyia		3	
EPHEMEROPTERA			
Acerpenna		5	4
Caenis latipennis	3	7	
Fallceon		1	2
Stenacron	1	1	3
HEMIPTERA			
Belostoma		-99	
ISOPODA			
Lirceus	1	3	
ODONATA			
Argia	1		
Boyeria		1	
Calopteryx		1	
Dromogomphus	-99		
Ischnura		2	
Libellula	-99		
Nasiaeschna pentacantha		-99	
TRICHOPTERA			
Cheumatopsyche		1	1
Hydropsyche			1
Ironoquia		-99	
Ptilostomis		-99	
TRICLADIDA			
Planariidae		2	
TUBIFICIDA			
Limnodrilus hoffmeisteri	2		
Tubificidae	6	2	1

Aquid Invertebrate Database Bench Sheet Report
Sni-A-Bar Cr [16068], Station #2, Sample Date: 3/22/2016 1:30:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
AMPHIPODA			
Crangonyx	1	3	
Hyalella azteca		1	
ARHYNCHOBDELLIDA			
Erpobdellidae	-99		
BASOMMATOPHORA			
Physella	-99	4	-99
COLEOPTERA			
Dubiraphia	2	1	
Microcylloepus pusillus		2	9
Paracymus			1
DIPTERA			
Ablabesmyia	3	2	1
Ceratopogoninae	6	1	1
Chironomidae	4	4	2
Chironomus	1	1	
Cladotanytarsus	1		
Cricotopus/Orthocladius	100	127	100
Cryptochironomus	6	1	
Cryptotendipes	15		
Dicrotendipes	6	4	28
Diptera	1		
Eukiefferiella		1	4
Harnischia	1		
Hydrobaenus	15	1	
Parakiefferiella	5	1	
Paralauterborniella	26		
Paratendipes	6		1
Phaenopsectra		1	6
Polypedilum fallax grp		2	4
Polypedilum flavum	3	50	48
Polypedilum illinoense grp	2	14	43
Polypedilum scalaenum grp	49	3	6
Pseudochironomus	1		2
Rheocricotopus			1
Rheotanytarsus	1	25	21
Saetheria	3		
Simulium		2	1
Stelechomyia			3
Stenochironomus			7

Aquid Invertebrate Database Bench Sheet Report
Sni-A-Bar Cr [16068], Station #2, Sample Date: 3/22/2016 1:30:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Tanytarsus	6	89	56
Thienemanniella		1	
Thienemannimyia grp.	2	10	11
Tipula		-99	
Tribelos			3
EPHEMEROPTERA			
Acerpenna	1	6	3
Caenis latipennis	6		
Fallceon	1	8	3
Leptophlebiidae		-99	
Stenacron	3		3
Stenonema femoratum	-99		
Tricorythodes	1		
HEMIPTERA			
Belostoma		-99	
ISOPODA			
Caecidotea		2	-99
LUMBRICINA			
Lumbricina	-99		
ODONATA			
Argia		1	
Calopteryx		3	
TRICHOPTERA			
Cheumatopsyche		5	1
Hydropsyche			2
Hydroptila			1
Ironoquia		-99	
TRICLADIDA			
Planariidae		1	
TUBIFICIDA			
Branchiura sowerbyi	6		
Ilyodrilus templetoni	1		
Limnodrilus cervix	4		
Limnodrilus claparedianus	3		
Limnodrilus hoffmeisteri	5	1	
Tubificidae	37		
VENEROIDA			
Corbicula	4		

Aquid Invertebrate Database Bench Sheet Report
Sni-A-Bar Cr [16067], Station #3, Sample Date: 3/22/2016 12:00:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	6		
AMPHIPODA			
Crangonyx	2	1	
Hyalella azteca	1		
ARHYNCHOBDELLIDA			
Erpobdellidae	-99		
BASOMMATOPHORA			
Ancylidae	1		
Menetus	1		
Physella		-99	-99
COLEOPTERA			
Dubiraphia	9	2	1
Enochrus	1		
Macronychus glabratus	1		
Stenelmis	1		
DECAPODA			
Faxonius virilis	1		
DIPTERA			
Ablabesmyia	13	1	
Ceratopogoninae	7		
Chironomidae	9	1	8
Chironomus	2		
Cladotanytarsus	1		
Cricotopus bicinctus	1	9	
Cricotopus/Orthocladius	79	107	139
Cryptochironomus	5	2	6
Cryptotendipes	18		1
Dicrotendipes	18	3	13
Diptera	2		
Eukiefferiella		4	8
Harnischia	1		
Hydrobaenus	7		
Ormosia	1		
Parakiefferiella	1		1
Paralauterborniella	21		
Parametriocnemus		1	2
Paratendipes	11		1
Phaenopsectra	3	1	
Polypedilum fallax grp		1	5
Polypedilum flavum		23	27

Aquid Invertebrate Database Bench Sheet Report
Sni-A-Bar Cr [16067], Station #3, Sample Date: 3/22/2016 12:00:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Polypedilum illinoense grp	2	9	3
Polypedilum scalaenum grp	21		2
Pseudosmittia		1	
Rheocricotopus		2	
Rheotanytarsus		1	2
Simulium		65	16
Stelechomyia	1		1
Stenochironomus			2
Tanytarsus	11	24	47
Thienemannimyia grp.	8	23	25
Tipula		1	
EPHEMEROPTERA			
Acerpenna	1	17	5
Caenis latipennis	9	1	
Fallceon		63	12
Hexagenia limbata	1		
Stenacron	2		
Stenonema femoratum	-99		
ISOPODA			
Caecidotea		1	
LEPIDOPTERA			
Noctuidae	-99		
LUMBRICINA			
Lumbricina	3		-99
ODONATA			
Argia		1	
Calopteryx	-99		
Nasiaeschna pentacantha		-99	
PLECOPTERA			
Perlesta		3	
TRICHOPTERA			
Cheumatopsyche		3	1
Ironoquia		-99	
TRICLADIDA			
Planariidae		1	
TUBIFICIDA			
Limnodrilus cervix	2		
Limnodrilus claparedianus	1		
Limnodrilus hoffmeisteri	6		
Tubificidae	9		

Aquid Invertebrate Database Bench Sheet Report
Sni-A-Bar Cr [16067], Station #3, Sample Date: 3/22/2016 12:00:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
VENEROIDA			
Corbicula	-99	3	
Pisidiidae	2		

Aquid Invertebrate Database Bench Sheet Report
Sni-A-Bar Cr [16066], Station #4, Sample Date: 3/22/2016 10:30:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	2		
AMPHIPODA			
Crangonyx	5	5	-99
Hyalella azteca		5	-99
ARHYNCHOBDELLIDA			
Erpobdellidae	1	-99	
BASOMMATOPHORA			
Ancylidae		2	
Lymnaeidae		1	
Physella		1	-99
BRANCHIOBDELLIDA			
Branchiobdellida	2		
COLEOPTERA			
Dubiraphia	5	8	
Dytiscidae	2		
Macronychus glabratus		2	1
Peltodytes		6	
Stenelmis		4	1
DECAPODA			
Faxonius virilis	-99		
DIPTERA			
Ablabesmyia	13	8	
Ceratopogoninae	4	1	
Chironomidae	2	1	4
Chironomus	1		
Cladotanytarsus	2		
Corynoneura			1
Cricotopus bicinctus		1	2
Cricotopus/Orthocladius	27	29	81
Cryptochironomus	8	2	
Cryptotendipes	21		
Dicrotendipes	5	3	6
Diptera	5	1	2
Eukiefferiella			5
Harnischia			1
Hydrobaenus	7	1	1
Nanocladius	1		1
Ormosia		1	2
Paralauterborniella	15	3	
Parametriocnemus		1	1

Aquid Invertebrate Database Bench Sheet Report
Sni-A-Bar Cr [16066], Station #4, Sample Date: 3/22/2016 10:30:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Paraphaenocladius		1	
Paratanytarsus	1	5	1
Paratendipes	45	20	2
Phaenopsectra	3	16	1
Polypedilum fallax grp	1	2	4
Polypedilum flavum		1	21
Polypedilum halterale grp	1		
Polypedilum illinoense grp	1	12	11
Polypedilum scalaenum grp	44	7	12
Rheotanytarsus	1	5	6
Simulium		2	14
Stelechomyia			1
Stenochironomus			4
Tabanus		1	
Tanytarsus	71	67	59
Thienemannimyia grp.	21	17	18
Tribelos			3
Zavrelimyia		2	
EPHEMEROPTERA			
Acerpenna		6	4
Caenis latipennis	17	4	
Fallceon		18	14
Stenacron	4	2	1
Stenonema femoratum	3		1
ISOPODA			
Lirceus	3	-99	
ODONATA			
Argia		1	
Boyeria		-99	
Calopteryx		5	
Enallagma		1	
Libellula		-99	
Nasiaeschna pentacantha		1	
PLECOPTERA			
Perlidae			1
RHYNCHOBDELLIDA			
Piscicolidae	-99		
TRICHOPTERA			
Cheumatopsyche	-99	1	5
Ironoquia	-99		
TUBIFICIDA			

Aquid Invertebrate Database Bench Sheet Report
Sni-A-Bar Cr [16066], Station #4, Sample Date: 3/22/2016 10:30:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Enchytraeidae			2
Limnodrilus claparedianus	1		
Limnodrilus hoffmeisteri		1	
Tubificidae	4	3	2
VENEROIDA			
Corbicula		1	-99